

Skyfall[#]: an extreme case of male-male aggression in Tokay Geckos (Gekkonidae: *Gekko gecko*) on Ataúro Island, Timor-Leste

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Tokay geckos (Fig. 1) are a noisy fixture in Southeast Asian rainforests, issuing their onomatopoeic calls from dusk to dawn (and sometimes even during the day) from diverse perches throughout a wide range of microhabitats, ranging from pristine to disturbed areas (e.g., Manthey and Grossmann, 1997; Chan et al., 2006; Grismer, 2011). Unfortunately, these geckos (especially their tongues!) have become threatened in their native habitats by international trade, and their conservation is becoming an international priority (Bauer, 2009; Subramanean and Reddy, 2012). Given how well this species advertises itself in its habitats and how high of an interest it commands in the field of herpetoculture (e.g., McKeown and Zaworski, 1997; Toth, 2020) and traditional medicine, it may be surprising that very few studies, as opposed to faunal surveys, deal directly with the ecology and behaviour of the species. Outside of the many notes on *G. gecko*, in which single dietary observations and aspects of natural history in introduced populations are reported, we found exactly two studies detailing the natural history of *G. gecko* more broadly and in what is presumed to be its native habitat, namely Stanner et al. (1998) and Aowphol et al. (2006). Furthermore, even though there is ample mention in the literature, as well as in online reports, of the aggressive behaviour shown by the species towards

humans and other geckos (e.g., Grismer, 2011; Kaiser et al., 2013) this behaviour appears to be a matter of general knowledge, yet there are no formal studies or scientific reports documenting this^{##}. Our report fills a gap in our understanding to show the extent of this species' aggressiveness.

Ataúro Island is a small (area 105 km²) Inner Banda Arc island of volcanic origin and lies ca. 25 km off the coast of Dili, the capital city of Timor-Leste. It has a fairly diverse reptile fauna, of which *G. gecko* is an audible, integral part (see Kaiser et al., 2013). On 31 January 2010, during our first survey to assess the island's herpetofauna, we witnessed an unusual behavioural episode involving *G. gecko*. While eight of us were walking along the island's main road in the evening (19:30 h) from Tua Ko'in Lodge (8.2531°S, 125.6072°E) southwards to the town of Vila, we heard *G. gecko* calls along the road. At one point, in a grove of tall trees that formed a canopy over the road, we heard a brief (< 1 min duration) noisy squabble above us, which culminated when a tokay gecko landed on the road right at our feet. This male individual displayed

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[#] Our title is a reference to the highly acclaimed 2012 James Bond film with the same name. Bond films are filled with male-male aggression, and in this case the topic of our paper literally fell from the sky. The title of the film actually references *Skyfall*, Commander Bond's childhood home in the Scottish Highlands.

^{##} Of course, as a popular terrarium animal, there exist reports about male-male aggression of *G. gecko* in captivity. For example, Borg and Borg (1981) observed how three wild-caught tokays from Bali fought and injured each other after having been placed into a terrarium, which led Borg (2004) to issue a "main rule" for keeping this species: do not keep males together.



Figure 1. Aggressive pose of a male *Gekko gekko* from Ataúro Island, Timor-Leste. While this is not one of the individuals involved in the altercation we describe herein, the photo serves to illustrate the fierce disposition and sharp dentition of these sizable lizards. Photo by Mark O'Shea.

no righting response or other movement and appeared dead. Shining our flashlights immediately up into the trees (approximate height 6 m above the road) allowed us to see an especially large *G. gekko* retreating along the length of a large overhanging branch. Closer investigation of the deceased individual (deposited in the collection of the United States National Museum, Smithsonian Institution, accession number USNM 579056) revealed a definite set of bloody toothmarks on both sides of its body and across its ribcage (more visible on the lighter-coloured venter), a match to the dimensions and dentition of *G. gekko*.

We reconstruct the episode as follows. Two adult male geckos with territories in trees on either side of the road forage along the edges of their respective territories and encounter each other on a branch over the road, which acts as a connector between established territories. In the ensuing agonistic encounter, both individuals vocalise and proceed to square off, including attempts to bite. During this vicious engagement, one gecko gains a firm hold on the other via a strong bite, inadvertently killing it in the process. Facing no further resistance and sensing no movement, the victor ends his struggle and releases the loser, who unceremoniously drops down to the road.

Our reconstruction of this tokay gecko aggression event, which was heard but only partially observed, is not merely based on assumptions but on solid circumstantial evidence. During our walk that evening, as on all night walks during survey periods, we looked

into the surrounding vegetation with flashlights. Based on the absence of rats, snakes, or birds in general during our walk and specifically along the branch and trees where the observation took place (and absent any rustling caused by other animals in the vicinity) and our knowledge of the different vocalisations produced by *G. gekko* (Yu et al., 2011), we discount the interpretation that our auditory observation was related to something other than intraspecific aggression. We had heard the characteristic territorial calls of the species numerous times from the bushes and trees lining the road and beyond. The overheard squabble involved clear intimidation „barks“ (sensu Brillet and Payette, 1991), to the exclusion of other types of vocalisation (i.e., this is inconsistent with a failed mating or predation attempt).

The bite force of *G. gekko* (Montuelle and Williams, 2015; Ross et al., 2018) is strong enough to break through the carapaces of large insects and the bones of small vertebrates, and it may well be forceful enough to squeeze the ribcage of a conspecific to exert sufficiently strong and sudden pressure on the heart and internal organs to cause death. We do not believe that the fall from the branch and the impact with the road had any causation in the demise of the individual we examined, given that tokays may jump some distance and there was absolutely no post-fall movement. While vocalisations are commonly used by these geckos in territorial displays and agonistic encounters, the type of intraspecific aggression we report here has never been documented in detail. Doubtlessly, many people have seen agonistic encounters, on account of *G. gekko* being firmly established in disturbed areas and even cities (Grismer, 2011), but only Chan et al. (2006) mentioned any intraspecific aggression among males. One probable reason for this is that most agonistic conflicts between *G. gekko* males do not lead to the fairly spectacular death of one of the combatants. We do not wish to imply that fighting to the death is anything other than a very rare and unintended consequence of regular territorial conflicts between conspecifics that are ordinarily relatively well-matched, but this encounter serves to illustrate the extreme vigor with which male *G. gekko* defend their territories from their rivals.

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